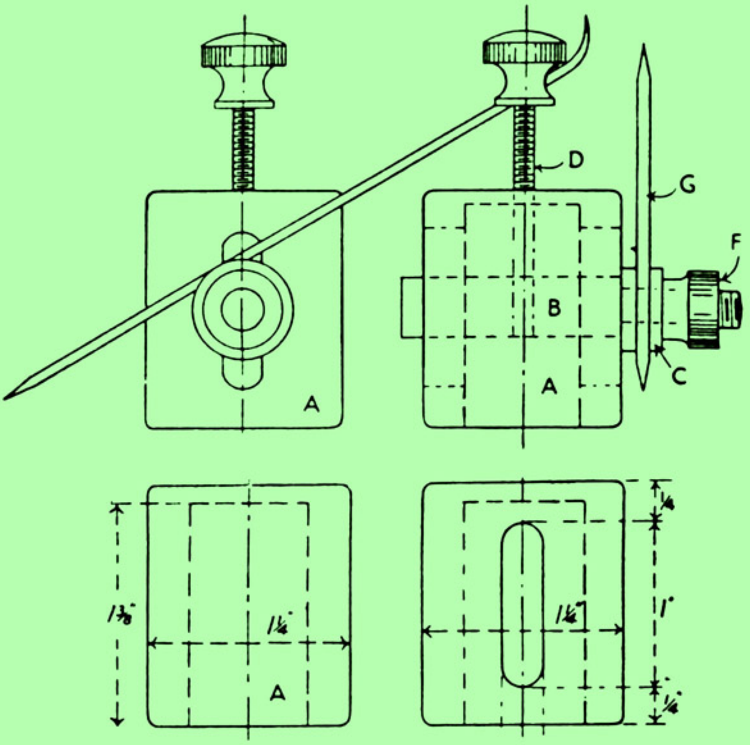
FIFTY USEFUL TOOLS

FOR THE HOME WORKSHOP



A.W.MARSHALL

FIFTY USEFUL TOOLS

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FIFTY USEFUL TOOLS

FOR THE HOME WORKSHOP

EDITED BY

ALFRED W. MARSHALL, M.I.MECH.E.

WITH 75 ILLUSTRATIONS

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PREFACE

In compiling a volume of descriptions of Fifty Useful Tools the Publishers recognise that many young mechanics and amateur workers depend, from choice as well as from necessity, upon their individual skill and efforts for at least some part of their workshop equipment. The tools described are also principally in the nature of "wrinkles" or "dodges" evolved by actual workers who have found them very useful. Such appliances are therefore rather outside the scope of tools made for the market.

Even the wealthy amateur is thus likely to find some value from these pages, not only in the particular merits of some tool, but also because it is "something to make." Though each tool has been described in the *Model Engineer*, this book will save a search through back volumes.

The Publishers gratefully acknowledge the work of the designers of the tools.

WARNING

It should be remembered that the materials and practices described in this publication are from an earlier age when we were less safety conscious. Neither the methods nor materials have been tested to today's standard and are consequently not endorsed by the publishers. Safety is your responsibility and care must be exercised at all times.

FIFTY USEFUL TOOLS

1. Hand-Tapping or Reamering Apparatus

This apparatus will be found very useful for reamering or tapping small holes. It can be gripped in the vice by piece B (fig. 1), and the work held with one hand while the other revolves the tool by means of the handle A.

For the construction, first take a piece of mild steel bar 1 in. by ¼ in., and cut off a piece about 10½ in. long. Now heat up at about 2¼ in. from one end and bend up carefully at right angles (it should be seen that these ends are bent at right angles). Then bend the other end the same, taking care that you get the required distance between each end. As it requires a good deal of skill to bend a piece in this manner, it would be better to bend to as near a dimension as possible and then alter the other parts to suit.

Another method is to get hold of a piece of metal 5½ in. long by about 2 in. or so across, and bend round that and then just square the ends up. The piece of metal need not necessarily be 5½ in.; it can be any length, but whatever length it is, the dimensions for the other parts will have to be altered in the same proportion. The next thing is to carefully mark out and drill out holes for spindle. These should be executed with a great deal of care, as the whole working of the apparatus depends on the bearings. If the holes are out of line, our spindle will either have to be turned small, and then will run very much out of truth; or be forced in, and then, of course, will run stiff. We should next turn our spindle to suit. A piece of bright mild steel rod would do very well, as this rolled steel is generally very round and practically up to size. After we have turned our spindle we should then turn our collars to suit, and drill and tap them as in fig. 3. The spindle

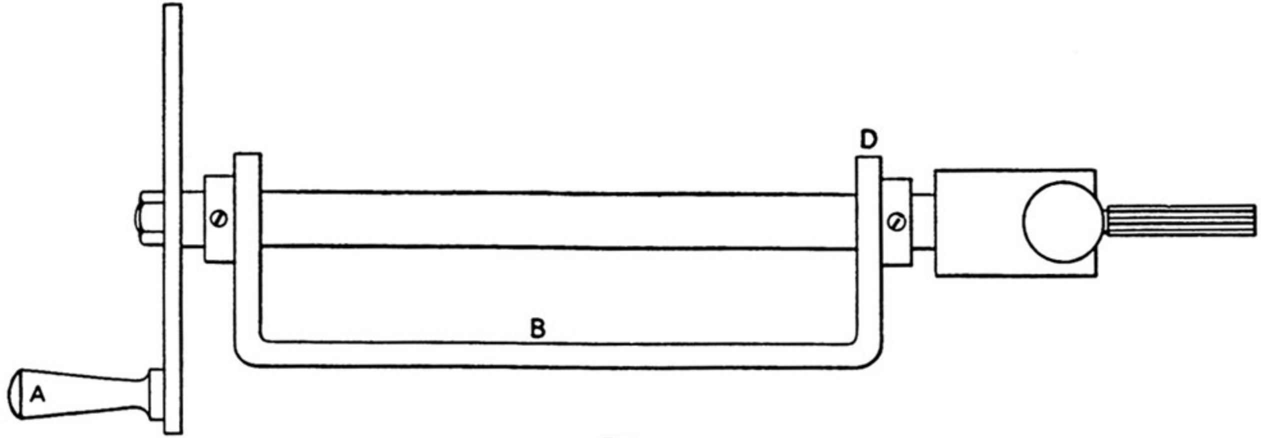


FIG. 1.

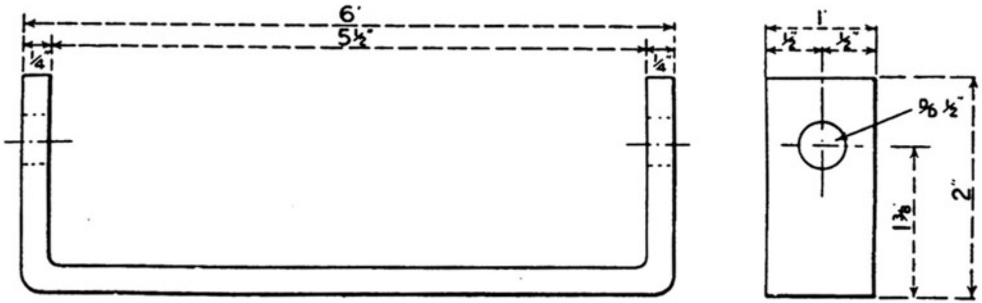


FIG. 2.

(fig. 4) should then be drilled as shown at C, and one of the collars fitted on and fastened with a 4 B.A. grub screw. Before fitting the spindle into bearing, we ought to face bearing down as shown where marked in fig. 1. Then put spindle in and ease-down to suit. Then surface down other end of bearing and put collar on other end of spindle, and drill spindle when in this position for other spindle collar. If thought necessary, two small holes could be drilled in bearing for lubricating purposes. The next thing to do is to machine the parts for the handle, viz. figs. 5 and 8, and fit up on our spindle. Then we have only the chuck left to deal with. The chuck shown in figs. 6 and 7 is a very crude design, but will suit most purposes. There is only accommodation for two screws, but two more can be fitted if required. A more elaborate chuck

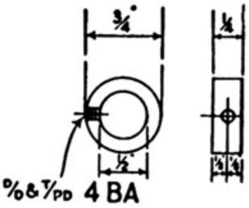


FIG. 3.

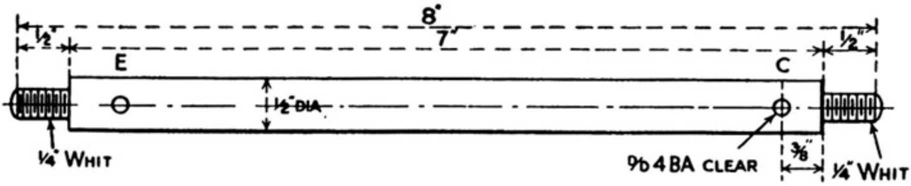


FIG. 4.

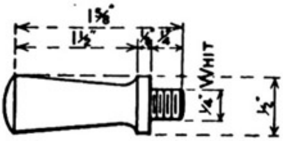


FIG. 5.

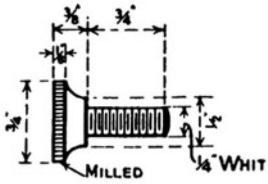


FIG. 6.

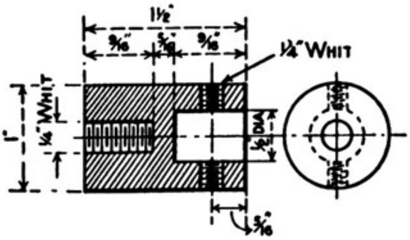


FIG. 7.

can be made, such as that described in the *Model Engineer* for 14th Nov. 1907, p. 468.

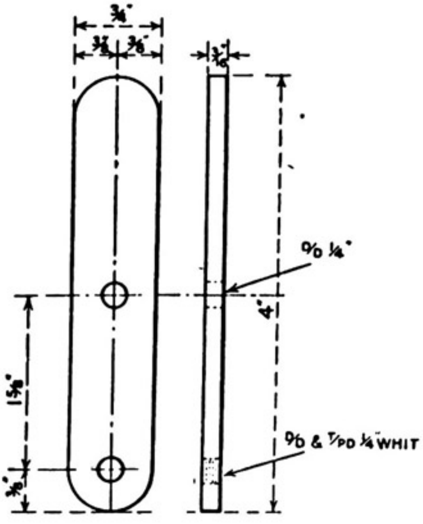


FIG. 8.

2. A Burnisher

A burnisher is a very useful tool in the model engineer's workshop, and an old half-round file provides just the material for the purpose. Having obtained one, first grind away all the teeth and round the corners until you have a smooth surface of the section shown.

Then, with an emery stick and No. 1 emery, the ground surface should be worked up quite smooth, and finally finished with No. 0 emery. When using the tool it is an advantage to have two handles, and for this an extra tang should be ground at the other end, as fig. 9. With the aid of this tool

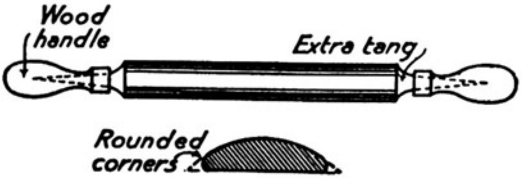


FIG. 9.

a brilliant finish can be given to such little things as screw-heads, cotters, and the like, and it well repays the time spent on its manufacture.

3. Forge Tongs

A very useful pair of tongs may be made in the following manner. First procure an old pair of long flat-nose pliers,

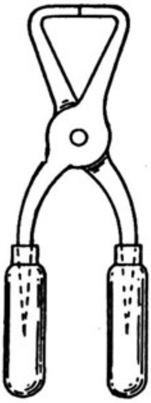


FIG. 10.

and bend about $\frac{3}{8}$ in. over at right angles, then file the ends square to meet properly. Now knock a tool handle on each handle of the pliers and the tongs are finished (fig. 10). These will be found invaluable when soldering strips of metal, etc., or for use on the forge, as they hold quite parallel and the handles do not get hot.

4. A Makeshift Pipe Wrench

A good substitute for a pipe wrench for small pipes up to ½ in. is made by placing a $\frac{3}{16}$-in. stove screw between the pipe to be turned and the fixed jaw of an adjustable spanner, as is shown in fig. 11.

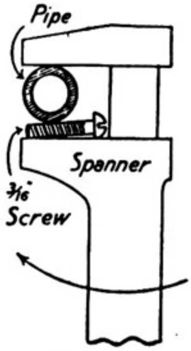


FIG. 11.

5. A Centre-Punch

A centre-punch of novel form, which will prove itself very useful in boiler-making and in work where a number of holes are to be marked out at an equal distance apart, is shown in fig. 12. Although very simple, it is much handier and quicker to use than dividers. The points of the punch and scriber should be set at the required distance, and after making the first indention put the scriber point into it and make another, and so on. To avoid the scriber slipping, a small locknut should be inserted between the setscrew and punch.

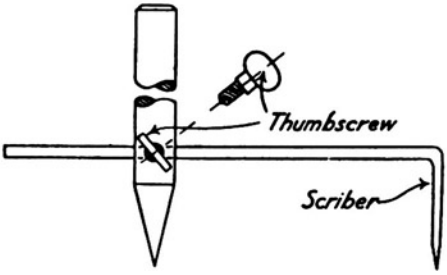


FIG. 12.

6. Adjustable Blowpipe for Gas

The chief feature of this device (fig. 13) is that the blowpipe is kept at the same distance from the gas jet throughout an operation of soldering, or whatever one may be doing. Also, the gas jet and blowpipe being fastened to one handle, one is able to guide the flame to any desired position while applying solder or holding the article with the other hand. The sketch explains itself. The whole tool is made of brass, soft-soldered where necessary. Air can be supplied from the mouth, but bellows would be better.

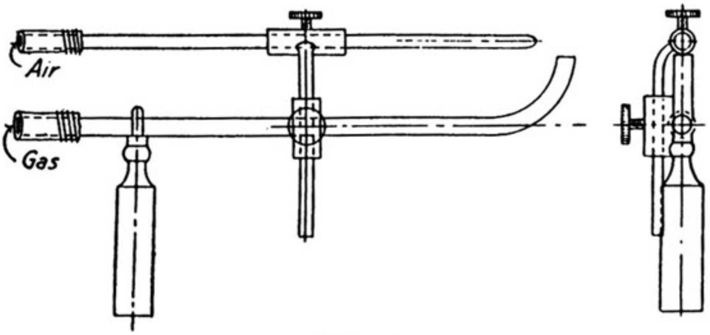


FIG. 13.

7. A Trimmer and Parting Tool for the Vice

As a trimmer, this can be used to cut off the surplus metal round the edges of a hole cut in sheet metal, and it could also be used to cut metal rods of various sections. Many other uses may be found for it. In place of the bottom chisel a flat-faced piece could be inserted, if required. As will be seen from the drawings (fig. 14), the frame is a casting, with circular ends 1 in. diameter. These are centred and drilled accurately, to take the ½-in. tool steel chisels.

The bottom chisel is secured in position by a setscrew, whilst the top chisel, being free to slide up and down, is prevented from rotating by means of a screw, the end of which has been turned down to fit without play in the slot. This pin should be case-hardened. The portion of the bottom chisel that fits in the frame should be turned down to ⅜ in.

The collar at the top end of the upper chisel is secured to the latter by a pin. The spring is of fine steel wire (about 22 or 24 S.W.G.), softened, then wound on a piece of ½-in. iron, made red-hot, hardened, and then tempered blue by heating the iron rod on which it was hardened, and then pushing it into the spring, twisting it round, until the desired colour is obtained.

To use the tool, it should be secured in the vice by the gripping-piece, so that the part of the frame containing the bottom chisel rests on the vice. This precaution enables a solid blow to be struck without danger of breaking off the end of the casting.

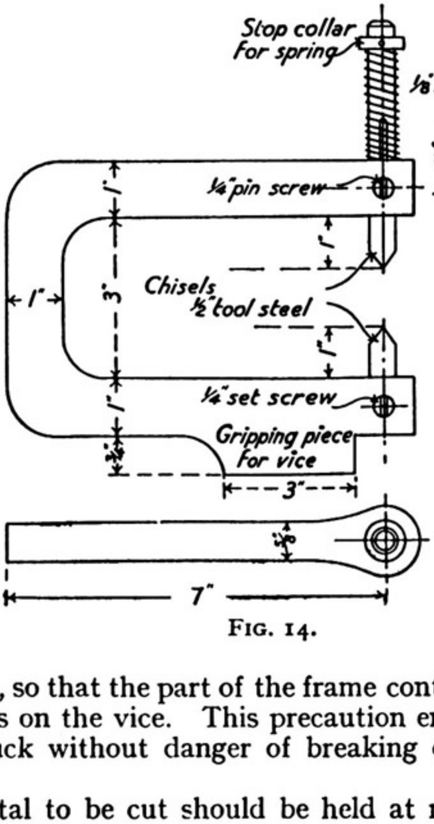


FIG. 14.

The metal to be cut should be held at right angles to the chisels.

8. A Ball-bearing Emery Grinder

One of the most useful devices of the model-maker's workshop is a serviceable emery grinder. Hours of weary filing, which seem to take all the pleasure from our work, will cease upon its introduction.

Tnis tool can be made with very little trouble, the emery wheels being the most expensive item to consider.

In the first place an old cycle hub—from any prehistoric wreck you may come across, and there are plenty in our ponds and streams—will be required. Cut this in half, as fig. 15. The spindle may be discarded, as it is too short for our purpose. Then cut two wooden blocks as standards (fig. 16), cutting a groove in the tops to receive the bearings, which are held in place by bent iron clips (fig. 17). A spindle is then made about 12 in. long, threaded to take the cones about 4 in. from each end; the thread will also take the nuts that secure the emery wheels.

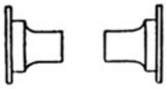


FIG. 15.

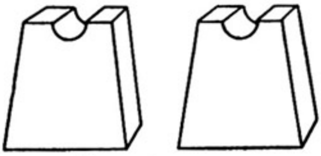


FIG. 16.

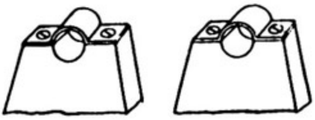


FIG. 17.

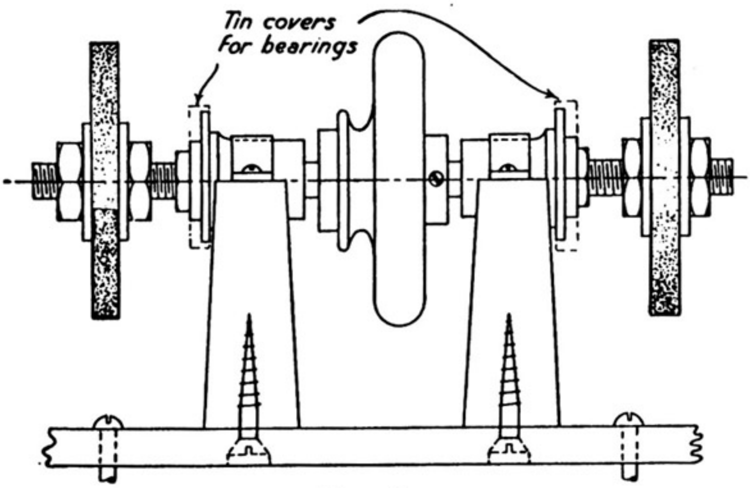


FIG. 18.

An old sewing-machine wheel and a few washers will complete our grinder.

Mount the wheel on the centre of the spindle, using the pin to fasten it, and assemble the bearings as illustrated (figs. 18 and 19).

To keep dust from the bearings screw over them a tin wing or guard.

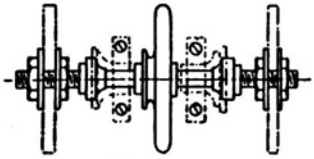


FIG. 19.

This emery grinder may be run on an old sewing-machine table, or from the flywheel of a lathe.

9. A Washer-Cutter

This little device (fig. 20) can be made in a few minutes from an old terminal of a porous pot, a piece of iron wire, and

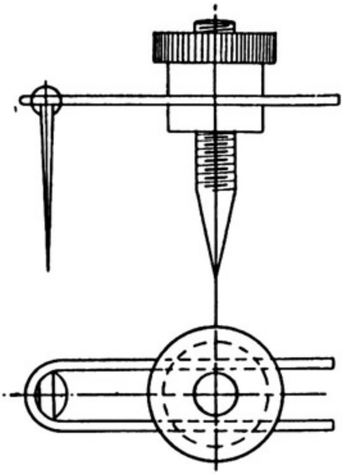


FIG. 20.

a broken keyhole saw. The knife is soft-soldered to the wire. This wire might, with advantage, be replaced by a sheet of brass with a slit in it for the terminal screw to pass through, as the wire is apt to bend in the process of cutting a washer. The disadvantage of this tool over a bought one is that you cannot cut washers with a diameter smaller than that of the terminal. It is best to hold the cutter perfectly still and to turn the leather round, as by this method one gets a less jerky cut.

10. A Chain Cramp

This cramp (fig. 21) is very easily made, and will be found useful for removing flywheels from shafts. Fasten the chains round the two opposite spokes and apply pressure with a bar. It can be used for strengthening shafts as shown. The chain being adjustable, it can be used for anything where pressure is needed.

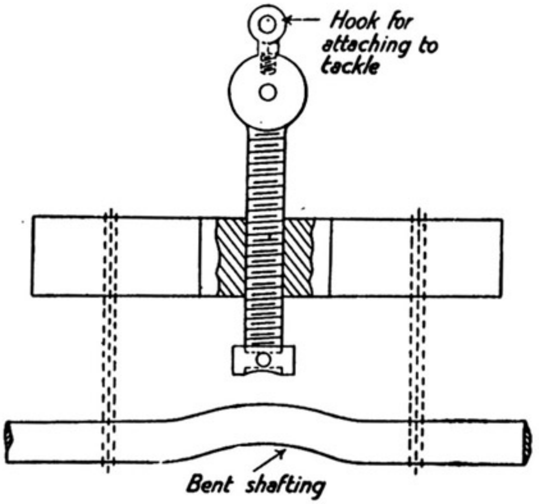


FIG. 21.

11. A Carrier for a Vice Prop

This contrivance is made out of $\frac{3}{8}$-in. iron. The spring of the metal holds the prop to the bench, thus supporting the

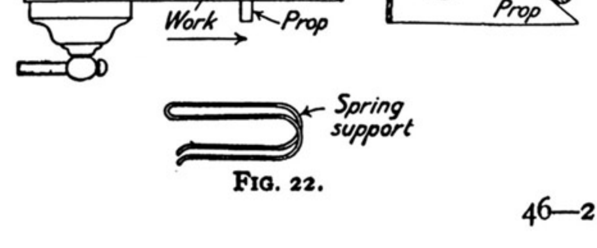


FIG. 22.

prop after the work has been removed from the vice for examination. In fig. 22 the bend A B (side elevation E) and the ends G (under the bench) grip the bench, whilst the two bends D and C (in side elevation F) grip the prop.

12. A Home-made Drilling-Machine Frame.

The baseboard (figs. 23 and 24) is a piece of hardwood, 24 in. long, 4 in. wide, and 1½ in. thick. To each side of this is screwed a strip of hoop iron, as shown in fig. 24, 2½ in. broad and about 22 in. long, which projects 1 in. in front of the base to keep the sliding portions of the drill in a vertical position.

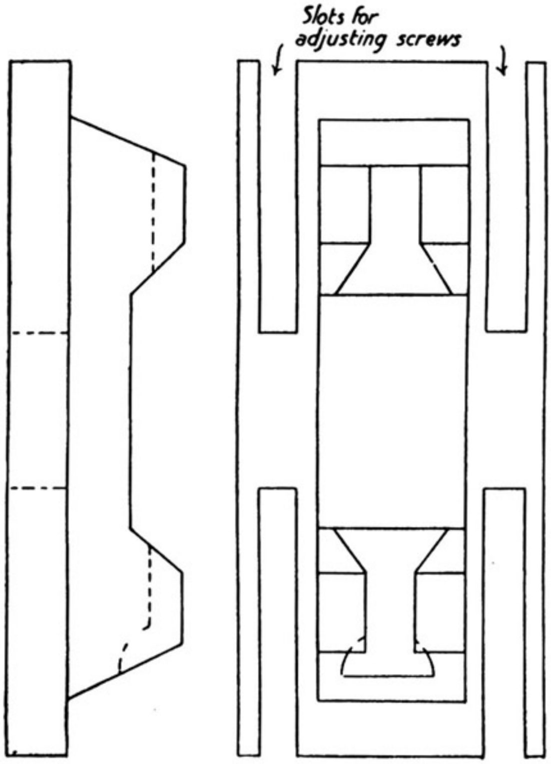


FIG. 23.

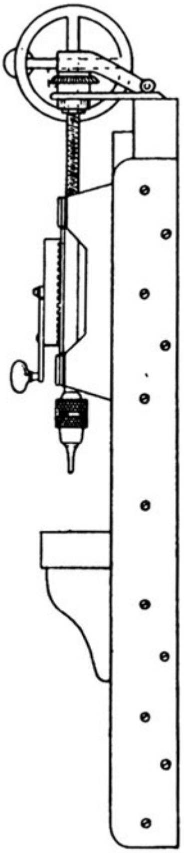


FIG. 24.

At the top of the base a piece of iron about 10 in. long and 2¼ in. wide is let in flush with back and bent over the top. The top part projects 3 in. in front of base. At the other end a slot is cut about 9 in. long and ½ in. wide, with a recess at the back, so as to allow the head of a bolt to slide up and down.

The table is made of hardwood, and covered with sheet iron, ⅛ in. thick, and filed flat. The sliding part is 6½ in. long, 4 in. wide, and ⅞ in. thick; the table is 4 in. square, firmly fixed to the sliding portion at right angles to the base, and supported by two brackets. It is held in position by a bolt and thumb-screw, so as to allow easy adjustment. The sliding portion of drill is a piece of wood, 9 in. long, 4 in. broad, and ¾ in. thick, held in position by four screws. Slots are cut for the screws, 3½ in. long and ¼ in. wide, which allow it to slide up and down. Screwed to this is another piece, 2 in. square and 7 in. long. Upon this is mounted a "Miller's Falls" hand drill. Both handles are removed from drill. The feeding screw, which is 6 in. long and ⅜ in. diameter, takes the place of the top handle. The top end of this rod is threaded for a distance of 4 in. Upon this is fitted a nut, turned, so as to pass through a ⅝-in. hole (see fig. 25), drilled in the top plate; a shoulder is left on the under side, and on the top side a bevel wheel is fixed.

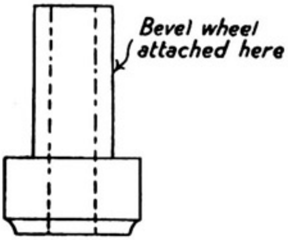


FIG. 25.

As will be seen by the drawing (fig. 24), another bevel wheel, which is fitted on an axle with a driving-wheel, engages with the one on the nut. On turning the driving-wheel the nut revolves, thereby causing the raising and lowering action. A space of about 8 in. is available between the table and drill, but I have centred the ends of an axle 18 in. long, the table being fixed in a suitable position below the drill. The feeding gear is satisfactory, being convenient, and speedy in action. It may be added that the bevel wheels were taken from an old sewing-machine.

13. An Improved V-Block

This V-block is shown by the accompanying sketch, fig. 25A. The advantages over the usual type, combined with extreme

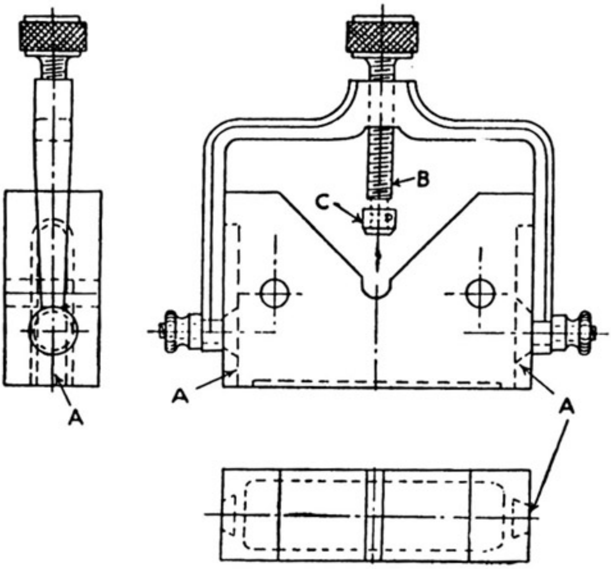


FIG. 25A.

simplicity, are as follows:—Having dovetail slots A, quick adjustment can be made when working with large or small diameters without moving screw B. When the work is set to the required position a turn of the screw B is all that is necessary to hold the work firmly in position, thereby ensuring perfect rigidity. A small brass plug C is fitted to the end of the screw B, thus obviating any possible danger of damaging the surface of the work. The length of slot A and screw B combined give equal facilities for clamping, whether the work be large or small, and for so small a tool it is obvious that a large range of sizes can be accommodated.

14. A Home-made Tube Vice

The sketches (figs. 26, 27) show a tube vice. It consists of an iron base to which are riveted two angle-irons (obtained from an old iron bedstead). To these two angle-irons are bolted on each end an upright, as shown; the uprights have a shoulder turned on the top to carry the crosspieces or yoke. The yoke is held down by nuts screwed on the turned portion of the uprights. The top piece is a jaw of iron drilled to take the bolts that secure the guiding strips on each side. The guiding strips cover the hole up in the top jaw. This hole, which is first drilled and then filed out, as shown, is to admit

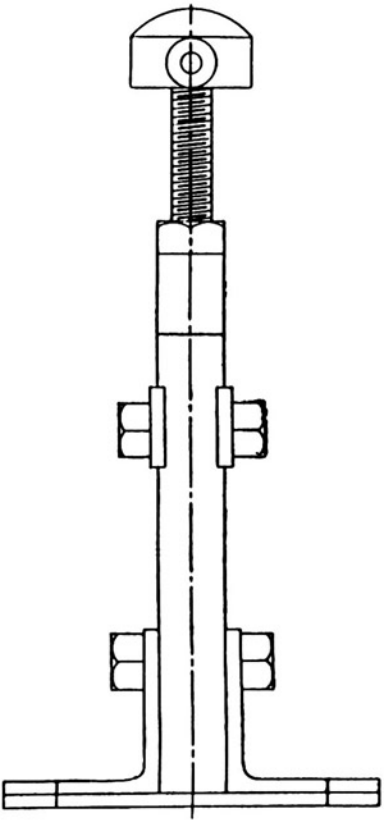


FIG. 26.

the washer being put on and the pin being put through the end of screw, as shown. This arrangement is to enable the top jaw being lifted by the screw. The screw is a round-headed bolt turned down and tapped $\frac{3}{8}$ in. The bottom end is turned down to $\frac{1}{4}$ in. to pass into top jaw as shown in sketch (fig. 28). The vice handle is a steel rod with two iron ends screwed on as shown. The gripping portion of the top jaw is filed to make the teeth as represented, and afterwards case-hardened. It acts efficiently and is very useful, as it will take up to $1\frac{1}{2}$ in.

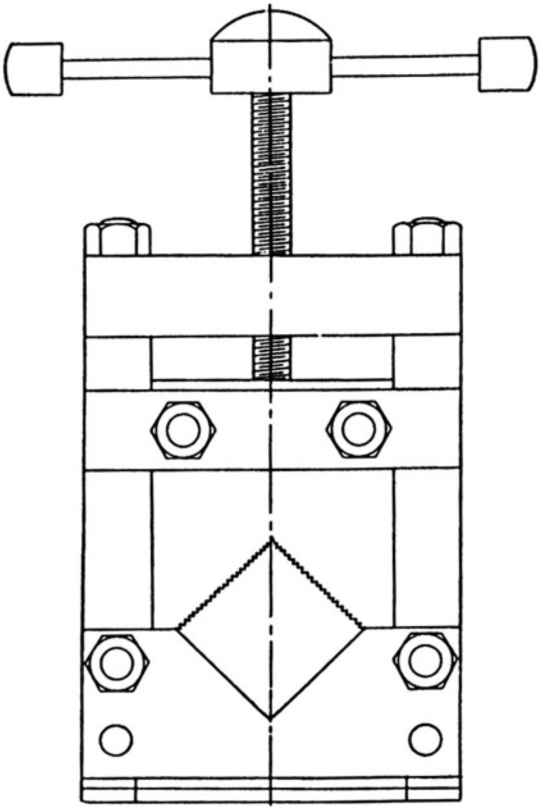


FIG. 27.

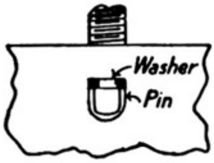


FIG. 28.

15. A Taper Reamer for Roughing-out Holes

The drawing herewith reproduced, fig. 29, shows a reamer for roughing out all kinds of tapered holes for valves and pet cocks. The shank and cutter holder D is turned from tool steel to within $\frac{1}{32}$ in. of the size wanted, then milled as shown at A. A second cut is taken on the milling machine as shown at E, leaving a recess to take the cutter blade B. The screw-holes in blade should be a little large to allow adjustment for wear, which can be taken up with strips of paper inserted behind it. The holder and blade must be hardened and ground to size.

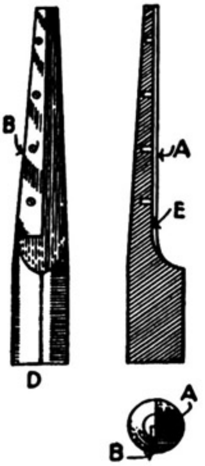


FIG. 29.

16. An Electric Light Bracket for the Bench

The following is a description of a handy electric light bracket, made to be fixed to the wall at the back of the bench, which is capable of movements to allow the light to be turned to any required position. The shaded part A, fig. 30, represents the wall to which the bracket B is fixed. This bracket consists of a piece of $1\frac{1}{2}$-in. by $\frac{1}{4}$-in. mild steel, bent to the shape shown, screwed to the wall and drilled to allow a piece of $\frac{3}{8}$-in. iron tube to go through; the tube is prevented from slipping through by an iron elbow, and is kept firm by a spring which is slipped on the bottom and is kept in its place by a cotter put through the tube. Fixed into the other end

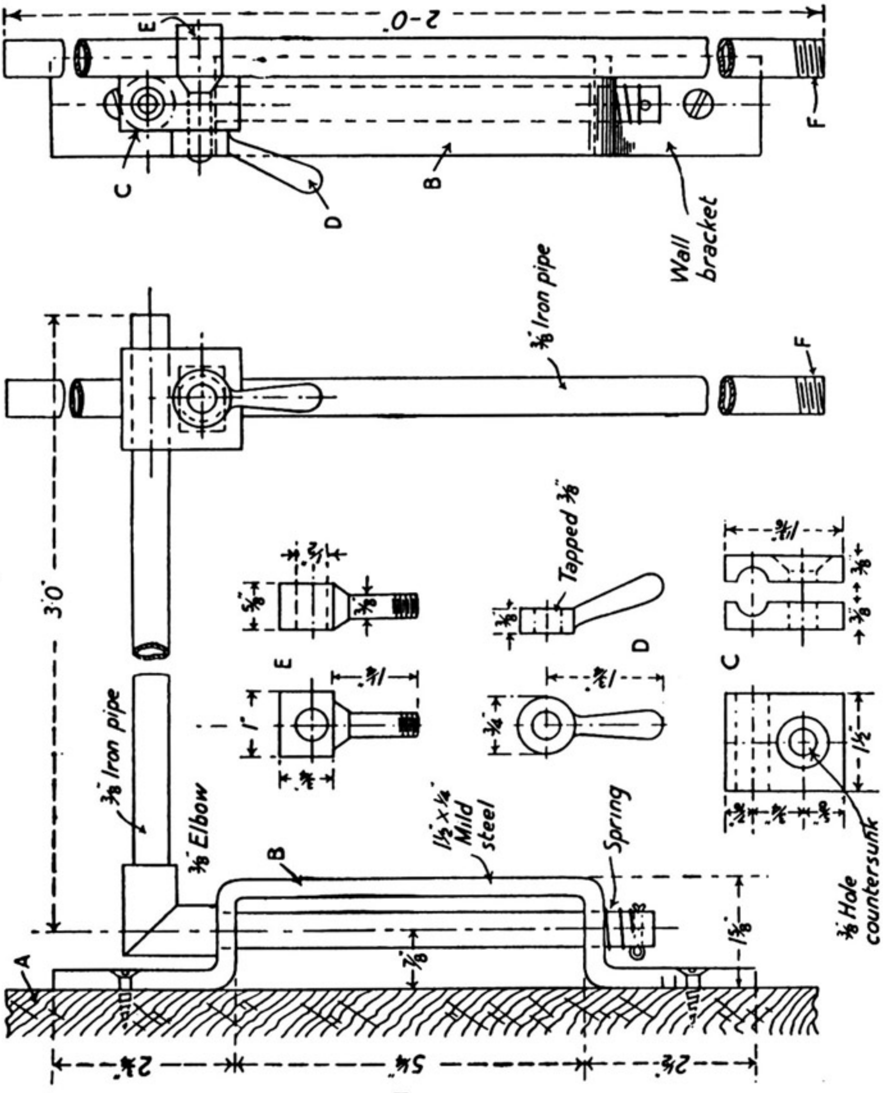


FIG. 30.

of the elbow is a piece of ⅜-in. iron tube 3 ft. long, which is thus able to swing from the wall on the right to the wall on the left. On this tube is a combination clamp C, made of brass, which can be made to slide from the elbow to the end of the tube, which it can be made to grip by a turn of the handle D. This movement also tightens another clamp, E, which grips another length of ⅜-in. tubing, 2 ft. long, the end, F, of which is screwed so that a bayonet lampholder can be screwed on, the flexible wires from the lampholder passing up the 2-ft. tube to a plug and socket (or its equivalent) on the wall. Thus, by loosening the clamp the tubes will be free to slide into the required position and tightened again by a turn of the handle.

17. Die Stock and Tap Wrench Combined

The length of the wrench shown in fig. 31 is 13 in., which is sufficient for a ½-in. tap. It should be forged to the shape shown; the slotted part can be drilled and filed out afterwards.

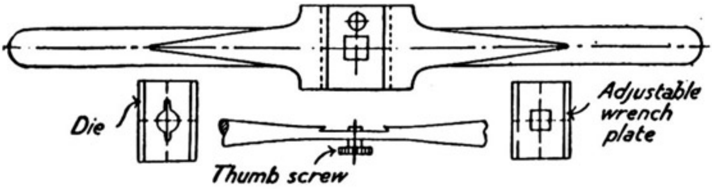


FIG. 31.

In the centre of the slotted part, drill a hole and file it out to the square form ½ in. diagonally. Drill the hole and tap same for a ¼-in. thumbscrew, which should be milled. The sides of the square hole should be case-hardened as follows: Heat the centre of the wrench to a red heat, then round the part to be case-hardened, spread a little prussiate of potash, rubbing around with an iron rod. Repeat this two or three times.

The wrench and die plates should be made of tool steel, the edges filed bevel to suit the slotted part of the wrench. It will be evident that the centre of these steel plates can take any form required. They should be about ¼ in. thick. It is a handy and useful tool in the workshop.

18. Blowpipe Apparatus

The sketch herewith, fig. 32, shows a useful apparatus for tempering, light forging or brazing, heating soldering irons, etc. The blowpipe is converted from an old petroleum brazer, which did not answer ; any blowpipe would do, I think. The apparatus consists of a foot blower, or a Chinese blower (as described in the *Model Engineer* for 22nd February 1906) would do, and a tank, which is formed from a biscuit tin. Make it thoroughly tight and insert a piece of composite pipe, horse-shoe shape, at the bottom. One branch from the blower is taken through this into the petrol, which then issues as gas from the top of tank, thence to blowpipe. This burns just as coal gas, and is a most efficient substitute where former is not available. The horseshoe must be perforated to admit the air into petrol, and the pipe feeding the horseshoe must be bent up above the level of petrol. Fill tank three-quarters full.

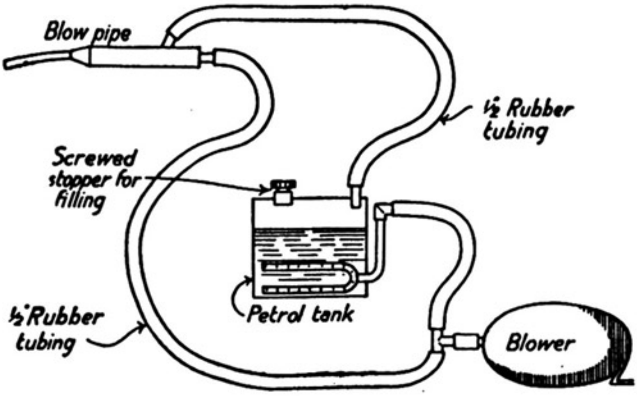


Fig. 32.

19. A Grinding Device

This grinding device is mounted in the manner shown in the accompanying sketch, fig. 33.

The metal wheel carries a strip of emery or corundum cloth, kept taut by a spring arrangement.

The wheel cannot get out of truth, and the cloth can be renewed when necessary. This wheel, 5 in. diameter, with about 1 dozen strips of cloth, cost about 15s. complete with driving spindle.

To keep grinding operations clear, the wheel is mounted on a wooden frame made of 3-in. by 2-in. pine. The bed B is 2 ft. 6 in. long, and the tailstock C is in one piece, with a corresponding length below the bed, which is gripped in the bench. The whole affair can thus be put up in a moment, and after use be put out of the way. The support D is a 1½-in. square piece, and wood cut to the right height and with a shoulder at one end to slip into gap at end of bedpiece.

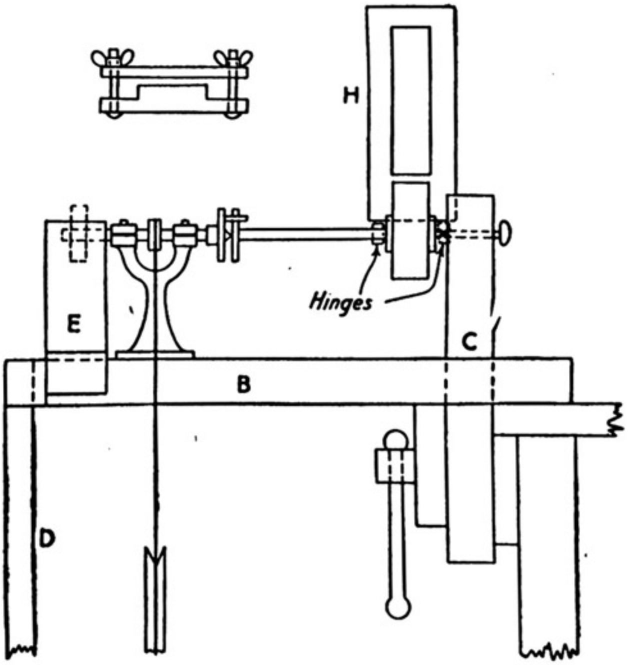


FIG. 33.

The headstock, a small polishing head, is driven by a foot-wheel fixed to the floor, and carries a driven chuck at one end and a small emery wheel, for roughing, at the other. E is a rest for use with this wheel; it is made of wood, faced with iron, and is screwed to the bed.

The rest for the wheel A is the frame H, which is fixed to the wall by strong hinges, and is lowered over the wheel when required. The tool to be ground is fixed to this with a clamp, I, made of wood and faced with iron.

20. A Method of Soldering Wire Connections

Fig. 34 shows an apparatus for soldering joints in bell-fitting work and small wire connections. The soldering of small wires is very troublesome at times. This arrangement is of assistance. The whole tool consists of a small methylated spirit lamp, and the saucer-shaped vessel is of copper, attached to the lamp by means of a wire having two spring clasps, by which it is attached to the lamp. A little solder is placed in the vessel and the lamp lit. The wires to be soldered are dipped into the solder.

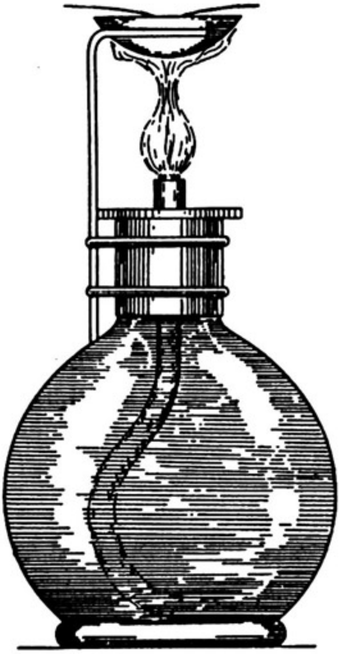


FIG. 34.

21. A Small Scribing Block

In order to get well to the bottom of such work as tools, jigs, etc., this tool is handy—most blocks are so far from the base. It consists of a block of mild steel or cast iron, 1¼ in. wide, 1⅜ in. in height, bored up ¾ in. diameter, 1⅜ in. long (A, figs. 35 and 36). It is slotted nearly to the bottom—right through; in fact, it can come through to the bottom, for the adjusting screw D will prevent the falling of the spindle B, which is the scriber carrier. The spindle, fig. 36, is mild steel; a piece of steel $2\frac{1}{16}$ in. long, filed ¼ in. to suit slot, leaving ⅛ in. for the head; the remaining part screwed ¼ in. for clamping

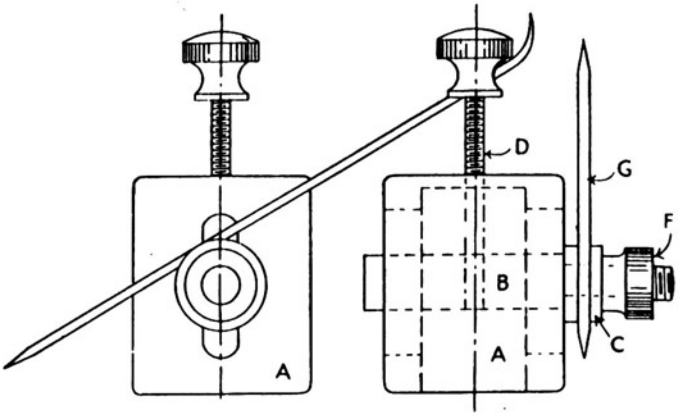


FIG. 35.

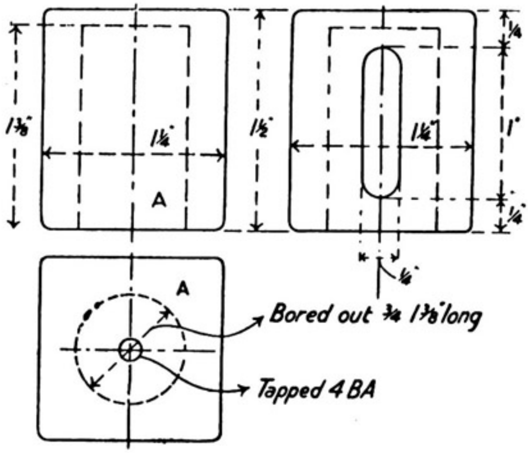


FIG. 36.

locknut F. D, fig. 37, is adjusting screw ; the block is drilled dead central with spindle ; the screw is left plain one end

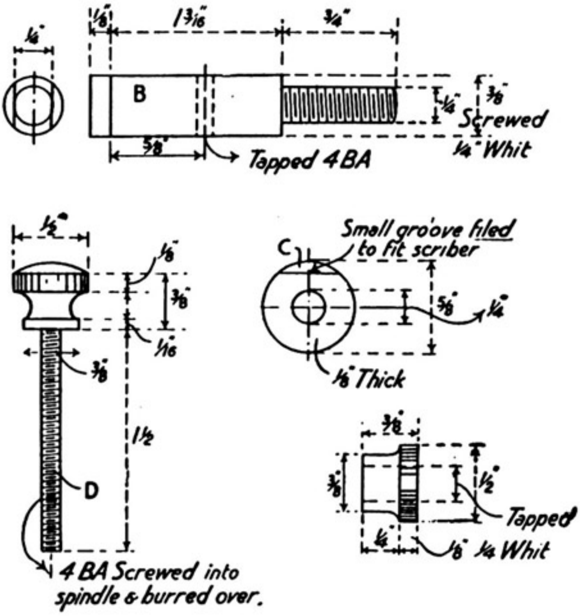


FIG. 37.

pushed in, and burred over well, just so that the screw will go round quite easily.

22. A Simple Drilling-Machine

The home-made drilling-machine, herewith illustrated (fig. 38) consists of an old lathe, with triangular bed inverted and bolted to a piece of 3 in. by 6 in. wood quartering, there being no poppet. A casting is made and fixed to the part where the hand-rest was originally attached, and a table 5 in. in diameter with a screw feed fitted in its place.

An American pattern chuck is fitted to the mandrel, and a ¾-in. flat belt passed round pulley and over two jockey pulleys on to the flywheel, which belonged to a sewing-machine.

The machine will drill a $\frac{3}{8}$-in. diameter hole in $\frac{1}{2}$-in. steel. It will also take very small drills without breaking them.

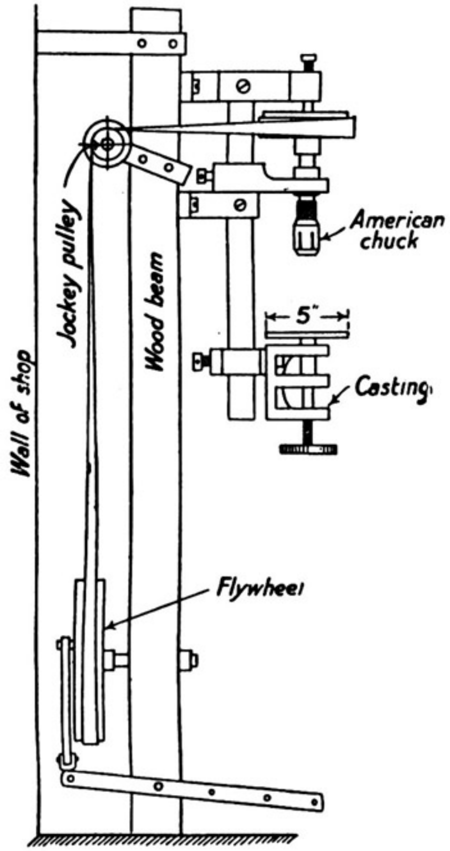


FIG. 38.

The whole machine takes up very little space, and is self-contained.

23. A By-pass Bunsen Burner

The following is a description of an easily made burner, which is useful for all small work where a good heat is required *intermittently*. As will be seen from the sketches, it is made from an incandescent gas burner; the only alteration necessary is to remove the tube A (fig. 39) and substitute a straight piece of tube C, which fits tightly over the nozzle B, as shown. The by-pass tube is bent straight and brought up outside the tube C, and overlaps it by about $\frac{1}{16}$ in.

The tube C has eight air-holes drilled in two rows, the bottom row being on a level with the nozzle. A short but intense blue flame is obtained, which is sufficient for all ordinary purposes.

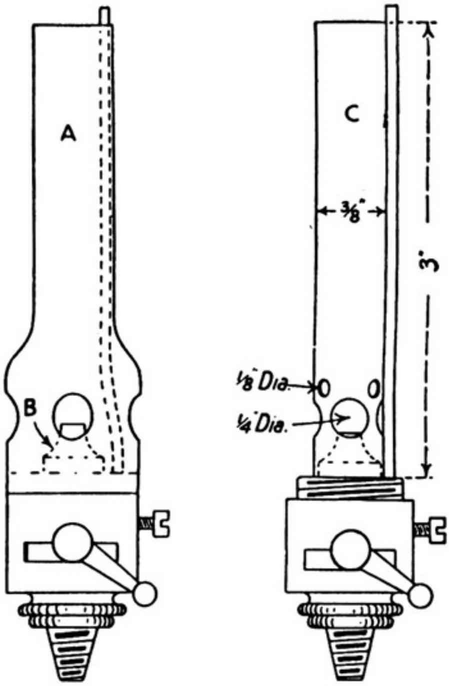


FIG. 39.

A sliding piece of tube can be placed on the tube C to regulate the amount of air, if necessary, but for delicate work it is sufficient to turn off the gas a little by means of the by-pass tap.

A similar burner can be used also for heating the ignition tube of a gas engine.

24. A Strong Vice Bench

This is made from a disused mangle, which can be purchased very cheaply from any old-iron dealer. Having procured one, take it completely to pieces. All that is required is to cut off the two uprights (fig. 40) which held the rollers, and to cut out the four small wheels on which it runs. Now put the framework together again, and fasten all bolts securely. At the top of the framework will be found two horizontal grooves, into which the washing-boards used to slide and which are generally about 1½ in. wide (fig. 41). If they *are* 1½ in., then procure some 1½-in. boards and cut them so as to be a tight fit in these grooves, and put two battens on the bottom to bind them together. These will form the table top.

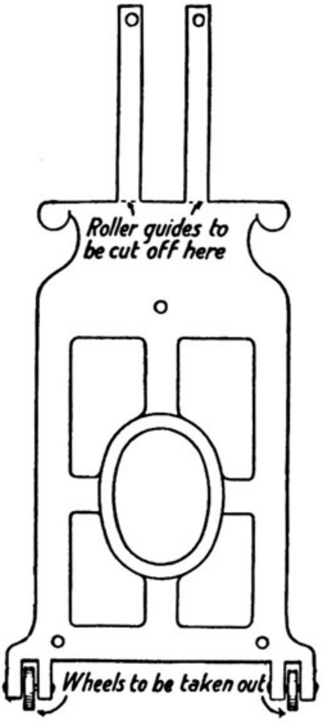


FIG. 40.

A casing should now be fitted, to cover the frame top where the roller guides were cut off, and continued across the back of the table, so as to keep anything from falling off. If a drawer is fitted underneath the table, it is now complete, and you have a vice bench which is *very rigid*, and which has cost practically nothing. If the workroom floor is cement, or anything inclined to be slippery, wooden shoes should be fitted on to the feet, to keep the bench from sliding about when heavy work is being done.

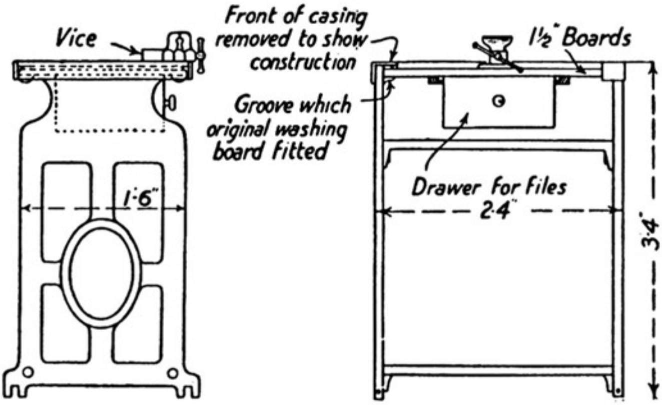

Vice
Front of casing removed to show construction
Groove which original washing board fitted
1'6"
1½" Boards
Drawer for files
2'4"
3'4"

FIG. 41.

25. A Combined Lead and Leather-faced Hammer

To make this useful appliance procure a 5-in. piece of thin iron piping, 1½ in. diameter (E, fig. 42). Drill and file out a slot to take the shaft; this slot B to be 1¼ in. by ¼ in., ends rounded as shown.

Next obtain a piece of 1-in. (outside diameter) iron pipe, 12 in. long; flatten one end for 1¼ in. to ¼ in. thick; the length of shaft should also be slightly flattened to afford a better grip. Fit the flattened end of shaft into slotted pipe, then push end C of slotted pipe into some sand for ⅝ in., and having clipped the end F with some blackened tin to form the lead face G, pour in some melted lead. Drive a steel wedge having very little taper in head end of shaft, as at D.

To form the leather face, roll a length of leather, ¾ in. broad, as shown, pinned at frequent intervals (H). Roll sufficiently to fit tightly in end C of head ; then drive in, a tight fit, and pin as shown at K. Trim up with the file.

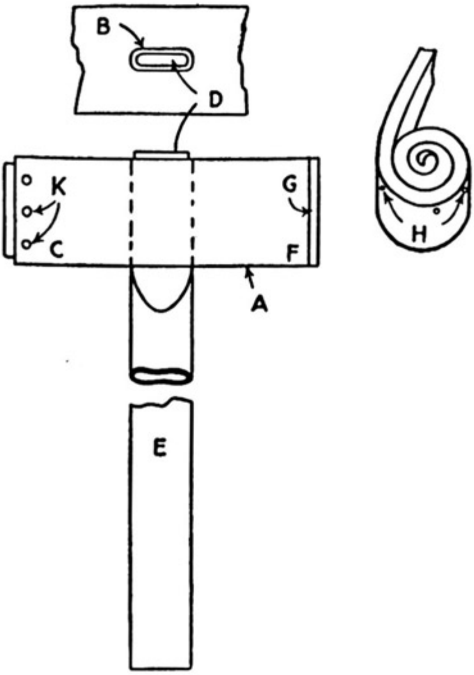


FIG. 42.

26. A Small Foundry Furnace

The accompanying illustration (fig. 43) shows a miniature foundry. It consists of a forge, furnace, water-motor, and blower.

This furnace, fig. 44, is made as follows :—A large pot is taken and a hole to admit a 1-in. pipe chipped near the bottom. The pipe is placed in position and a square block of wood, nearly as large as the pot, placed centrally in the pot. Run a mixture of two parts fireclay and one part sawdust while wet between the square piece of wood and walls of the pot for about 3 in. in height. When this has dried the piece of wood should be pulled out and a piece of thin steel strip bent

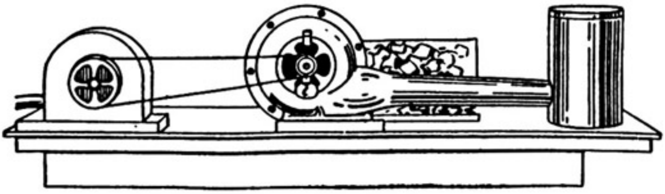


FIG. 43.

slightly larger square than the square hole left by the wood. Slots are then cut in two opposite sides of the steel square

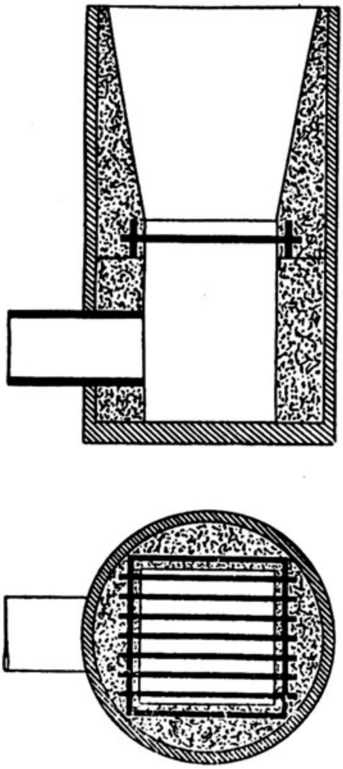


FIG. 44.

and little bars slipped into them. The square and bars are then placed on the square hole and the pot lined to the top with fireclay mixture. The square is thus protected from oxidisation. The accompanying drawings show the method of construction clearly. A small forge can be made from a shallow triangular box with one side extended in height. It is filled with fireclay, and the front of extended side through which the blast is led, lined with fireclay. It can just be seen behind the blower. Either the forge or furnace can be used by slipping their supply pipes to a fit on the tapering blast pipe.

This little set is very useful for small brazing, forging, and particularly for steel hardening and tempering. The temperature of the furnace can be regulated by adjusting the water tap supplying the motor. The fan delivers air at a steady pressure, and being power-driven gives a steady heat and allows the operator to concentrate his attention on the work in hand.

27. A Makeshift Vice

A handy vice can be made as shown below in the accompanying diagram (fig. 45) by means of two ordinary clamps placed in the position indicated. An arrangement such as this is useful for holding small articles quite firmly.

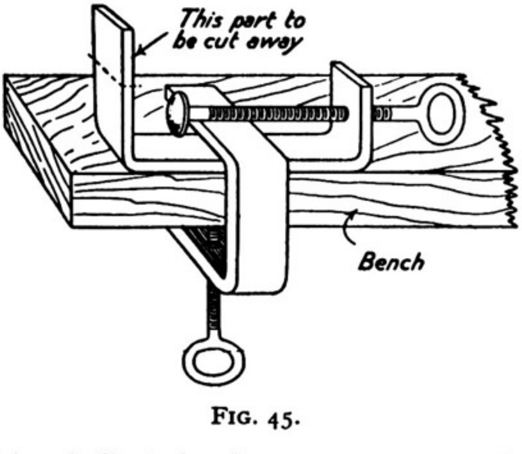


FIG. 45.

28. A Home-made Brazing Lamp

The drawing herewith (fig. 46) shows this brazing lamp. The body of the lamp is made of two pieces of No. 18 gauge lead-coated steel ; each side is flanged, and one side groove seamed. The whole is to be bent as near round as possible, and then groove seamed the opposite side up, and flanged at the top and bottom ends. Two circular discs are cut out and flanged to fit the top and bottom. The whole of the body to be well soldered up. A long strip of the same metal is wired on each edge and drilled and bent to receive the wood handle, and then soldered in position on the body. The wood handle is fixed by passing a long rivet through it. Four pieces of metal should be cut out for feet and soldered to the bottom to take the wear. The top fittings, needle valve and nipple, are all old petrol motor burner-fittings. The vaporiser and nozzle and spirit tray are castings. The pipe that conducts the oil from the needle valve to the vaporiser is an odd piece of ¼-in. gas pipe screwed into the needle valve branch and the other end into the vaporiser. The vapour pipe is a piece of ¼-in. copper pipe bent to shape and screwed into the top of the vaporiser. The part that receives the nipple is a piece of ¾-in. brass rod 1 in. long ; two holes are drilled into it at right

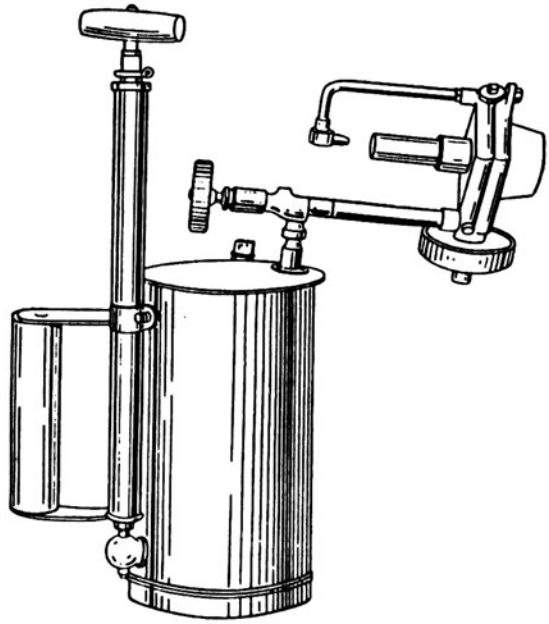


FIG. 46.

angles to each other; one is tapped to receive the vapour pipe, and the other the nipple. The part soldered to the top of the lamp body which receives the needle valve, etc., is part of a petrol motor dash-fitting. The pump is that of an ordinary cycle, fixed outside. The bottom fitting, which forms the ball valve as well as the pump fixing, is a small petrol cock with the handle of the plug sawn off and screwed up tight and fixed bottom upwards as shown in fig. 47, and the bottom of the pump screwed on to the screwed part of the plug. The other part, which is soldered into the body of the lamp, has been enlarged on the taper to receive the ball, and a small disc of brass is made, with several small holes drilled through it, and soldered to the entrance of the hole to prevent the ball getting out of position. The top fastening of the pump is by two $\frac{3}{16}$-in. bolts, soldered by their heads to the body of the lamp, one each side of the pump barrel, and a brass clip secured by nuts. A screwed brass plug is soldered into the top of the pump plunger and a wood handle bolted on. The vaporiser is drilled out $\frac{3}{16}$ in. diameter, and four small screwed plugs are screwed into the ends of the holes. Two small screws hold the nozzle to the vaporiser. A small stud is screwed into the bottom of the vaporiser to which the spirit tray is screwed. The filler is part of an old oil-can. A thimble-shaped spring out of thin brass, as shown in fig. 48, is fixed inside the leather plug in place of the brass collar to prevent air passing the leather plug, and the whole carefully inserted into the pump barrel. The centre air tube is a piece of old $\frac{3}{4}$-in. cycle tube,

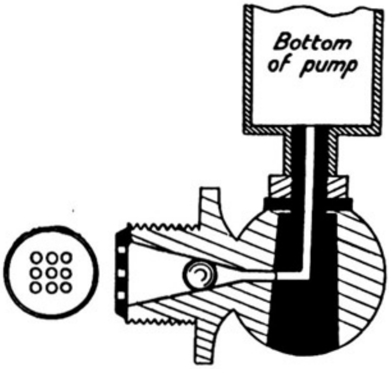


FIG. 47.

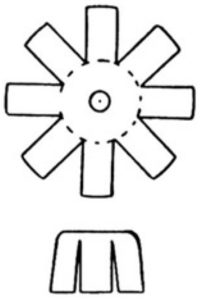


FIG. 48.

driven through a hole cast in the centre of the vaporiser. Adjustments with the nipple and nozzle may be necessary for the lamp to work well.

29. A Device for Drilling in Awkward Places

The sketch herewith, fig. 49, will explain a simple drilling device suitable for drilling small holes in places wherein you could not get your hand. As will be seen, the appliance consists of a length of 1¾-in. by 1-in. flat iron, at one end of which a hole is bored for the drill. A piece of ½-in. by ¼-in. iron is bent to the shape shown, and is attached to the long flat member. The bent piece takes the thrust of the drill by means

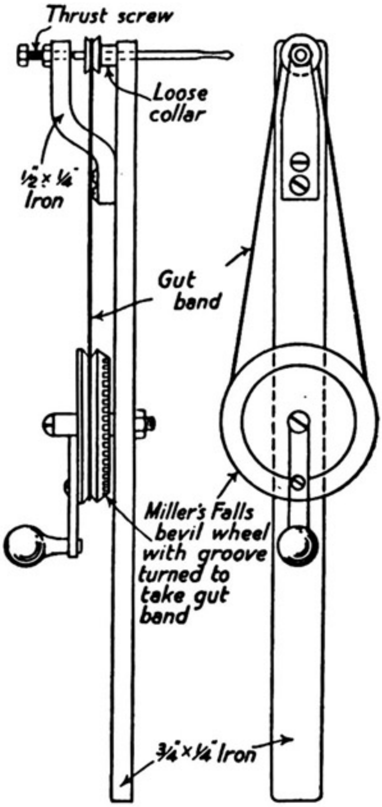

Thrust screw
Loose collar
½" × ¼" Iron
Gut band
Miller's Falls bevil wheel with groove turned to take gut band
¾" × ¼" Iron

FIG. 49.

of the stud and nut, as seen in the sketch. A small grooved pulley is driven tightly on to the drill; this is driven by a gut band from a grooved wheel, with handle attached—in my case, a " Miller's Falls " bevel wheel, with a groove cut in it.

30. An Anvil or Truing Plate

This can be made as follows:—Procure an iron, such as is used for domestic purposes. Next prepare two pieces of hard wood (5 in. long, 4 in. or 5 in. deep, and 1¼ in. thick); cut in each piece a recess equal to half the thickness of the handle of the iron, as shown in fig. 50. Having done this, next drill three holes in each half for ¼-in. bolts; now mount the iron in the blocks and screw up the bolts, and the anvil is complete. It will be found a very useful addition to the amateur's workshop.

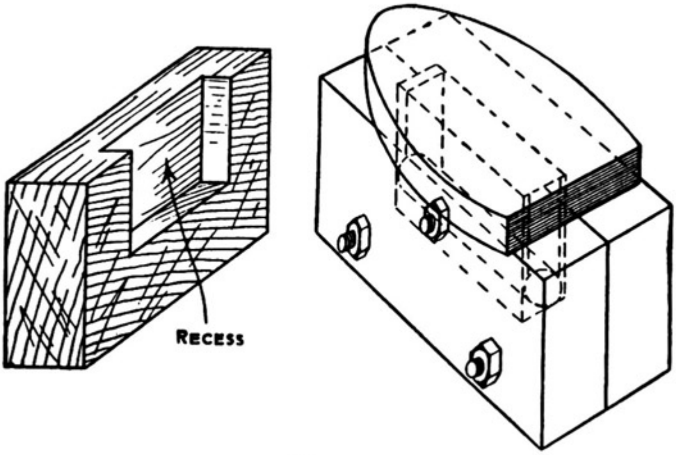


FIG. 50.

31. A Handy Soldering Furnace

The following is a description of a very handy double-burner soldering-bit stove. The burner is made out of ⅜-in. gas fittings. A T-piece, two elbow-pieces, two caps, a diminished socket, and about 16 in. plain tube will be required. The construction is clear from the drawings (not to scale). The cover is made out of ⅛-in. sheet iron. The top should have some holes drilled in it to let the fumes out. The bottom consists of about six $\frac{3}{16}$-in. iron rods, put across and tightly held with nuts at each side to keep it firm. There are also two more rods to each soldering-bit to lodge them on, as shown by the drawings. The legs consist of four strips of $\frac{1}{8}$-in. iron 1 in. wide, fixed to side by three screws. They should be about $2\frac{1}{2}$ in. long, 1 in. for fixing to cover, and might also be bent out a little. Two suitable rests must be made to support soldering irons.

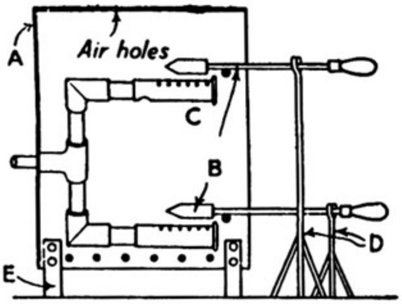
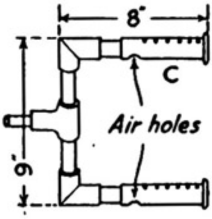


FIG. 51.



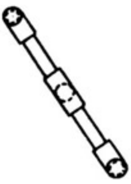


FIG. 52.

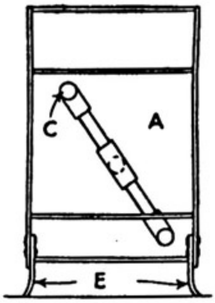


FIG. 53.

Referring to drawings (fig. 51) :—A, cover ; B, soldering irons ; C, burner ; D, soldering-iron supports ; E, legs. Fig. 52 is a detailed view of burners, showing how they must be fixed at an angle, so that the upper does not come directly over the lower one. Fig. 53—front view, showing support bars. This is a very useful soldering-iron stove, as both irons are ready when required, which necessitates very little waiting, if any, for the second iron when the first has become cold.

32. A Simple Bench Drill

The following is an arrangement of a bench drill which may prove useful to those who do not possess a drilling-machine.

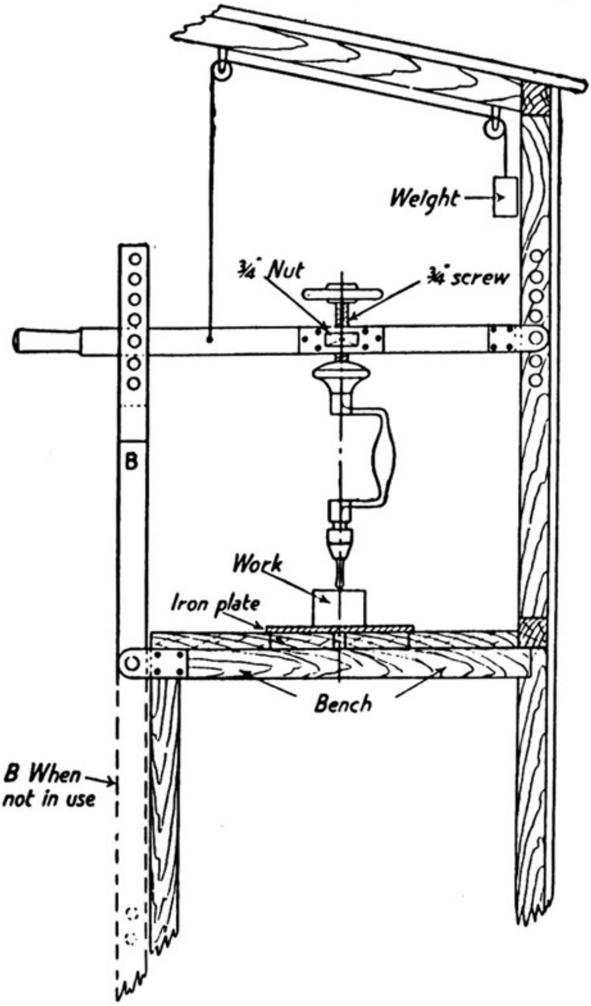


FIG. 54.

The arrangement is very simple, and very easily and cheaply made. Referring to fig. 54, the pivot for the lever A is an upright beam through which holes are drilled, as shown, to suit the height of the work to be drilled. In the lever A (fig. 55) a slot is cut to take a $\frac{3}{4}$-in. nut or a piece of tapped plate, and to compensate for the loss of strength two stiffening plates are fitted at sides. The weight shown keeps the lever suspended out of head room when not in use. The lever B is pivoted on the bench, as shown, and has corresponding holes in it to suit the upright beam. When wanted to do heavy work, the lever B is put in position and the feed put on by the screw shown. When not in use, the lever B falls down out of the way, as shown in dotted lines. This makes a satisfactory drilling-machine.

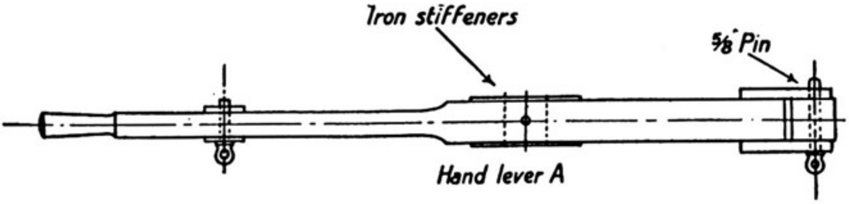


FIG. 55.

33. Shortening Small Screws

Sometimes when using small button-head or countersunk screws it is necessary to shorten them one or two threads, or to take the sharp edge off the threads. Drill a hole through a thin strip of metal to fit the screw, and bend slightly more than 90 degrees (fig. 56). Put a screw through the hole and fasten in the vice, as shown. By bending slightly more than 90 degs. the head will be drawn down tight on to the top of the vice.

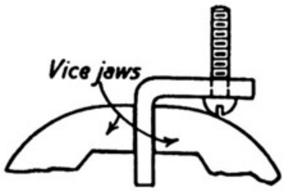


FIG. 56.

34. Spanners for Light Work

The following spanners will be found to be very useful for all kinds of light mechanical work, and therefore the model maker will do well to make them part of his tool kit. Fig. 57, A, will be found useful for screwing in or unscrewing studs, the teeth (which should be very fine) biting into the stud and thus ensuring a firm grip. One disadvantage with this, however, is that the studs are slightly damaged by the teeth. To overcome this the spanner shown in fig. 57, B, is extremely useful. To screw a stud in with this, a nut must first be screwed on to the projecting end of the stud, the spanner must then be screwed on to this and locked by means of the nut. To unscrew a stud the spanner is screwed on first and the nut afterwards, and the two locked together; a very firm grip can then be obtained, and even the tightest of studs can be

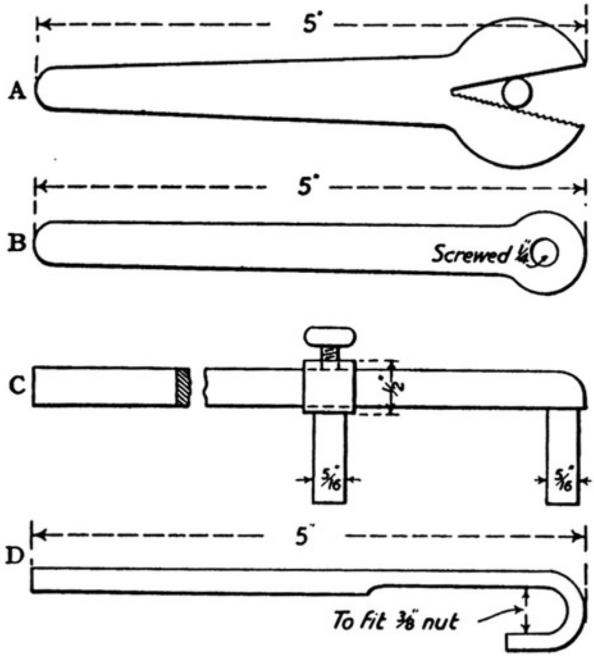


FIG. 57.

moved in this way. Of course, it must be remembered that one spanner must be used for each size stud used.

The third spanner (fig. 57, C) is a very handy tool for the twisting of wheels, fluted nuts, and many other kinds of screwed work. This is made out of a $\frac{3}{8}$-in. square steel bar with one end bent at right angles and then turned or filed to $\frac{5}{16}$ in. diameter. A sliding-piece must be made so that different size wheels and nuts can be taken; this is made out of $\frac{1}{2}$-in. square steel, one end of which should be turned to $\frac{5}{16}$ in. diameter, and the same length as the part that is bent round. A $\frac{3}{8}$-in. square hole is then put into this for sliding up and down the rod, and also a $\frac{5}{16}$-in. hole (screwed) for the screw to tighten this on to the rod.

The last spanner (fig. 57, D) is handy when working in awkward corners, as it can be placed on to the nut parallel to any projection, and then turned round as the nut is gradually tightened.

The sketches are not fully dimensioned, as many workers will want many sizes, but the dimensions can be copied off the drawing and made proportionately larger or smaller, as the case may be. Spanners A, B, and D, however, are made out of $\frac{3}{16}$-in. steel plate.

35. A Saw

The accompanying sketch, fig. 58, shows a handy saw that can be easily made out of an old hacksaw blade and a piece of sheet brass. The brass is bent in the shape of a U, and the hacksaw blade put in, and the whole squeezed together in a vice. The end is then filed to a point, and inserted in a handle. The saw is very useful for slotting the heads of screws, cutting very small keyways, etc.

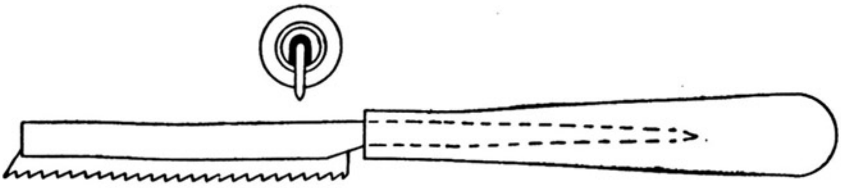


FIG. 58.

36. Drilling Large Holes

A very simple method of drilling large holes in a small drilling-machine may be accomplished in the following manner:—A, fig. 59, is a steel rod with a square hole cut in it at the bottom for the cutter D, which is made of square tool steel with the cutter part F forged to shape and set by nut B; the shank E and the guide C must be turned down to a shoulder. A hole the size of the guide C must first be drilled in the work and then the cutter adjusted to the size of the hole to be cut.

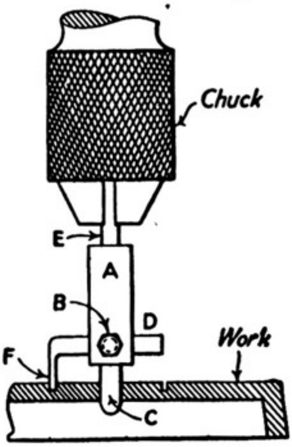


FIG. 59.

37. A Clamp to Hold Wire while Soldering

This clamp may be made any size and of almost any material, soft iron being preferable, however. It is used for holding wire or small metal pieces while soldering or brazing. The hand screws B, fig. 60, should be somewhat harder than the arms and clamps. The machine is very flexible, and rods can be held at any angle by adjustment. A indicates the vice jaws,

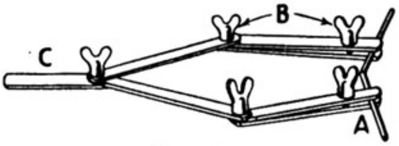


FIG. 60.

and C the handle. It is of especial convenience in soldering, as one or both hands may be free to spread the solder or flux.

38. A Punching Device

From a bar of iron 1 in. broad by ½ in. thick cut two pieces 6 in. long and one piece 2 in. long; rivet them together, as shown at *a*, fig. 61. Underneath secure a strip of ⅛-in. iron, 2 in. broad, by counter-sunk screws, two holes to be drilled on each side to take screws to secure the appliance to the bench.

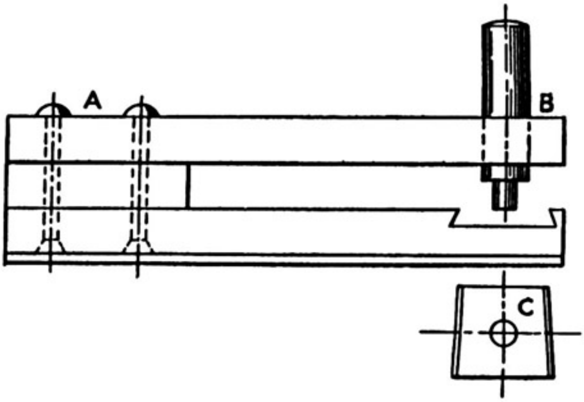


FIG. 61.

At the other end, *b*, drill a ½-in. hole through top of bottom bar. File out the bottom bar as shown. It is evident that any size of punch can be used from ½ in. downward; the ¼-in. punch is shown in position. For each punch a separate die will be required; these must be filed to the shape shown at *c*, so that when slipped in position under punch they will be in the right place when they can be pushed no further. Each punch must be turned so as to just fit the hole drilled in the die.

39. Shortening Small Screws

This clamp (fig. 62) consists of a piece of common iron or mild steel about ¼ in. thick, and can be made out of the solid and the slit put in with a hack-saw, or a piece of ¼-in. square stuff may be bent to shape. The screw to be shortened is screwed into one of the holes according to size, and the clamp then nipped between the vice jaws. This clamp will be found handy for short grub screws, as a head is not needed to prevent the screw from turning.

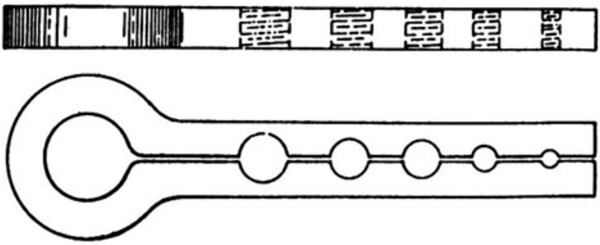


FIG. 62.

40. An Inexpensive Lever Press

This lever press is made from gas fittings, at a cost of about 1s. 6d. The barrel used is ¾ in., the top tee being bushed to take a ½-in. iron spindle. This spindle is screwed ¼-in. gas-pipe and a socket screwed on, the socket being slotted to take lever. Spindle to be bored to take ¼-in. steel tool, and bored out of centre to leave sufficient metal for set-screw. This set-screw

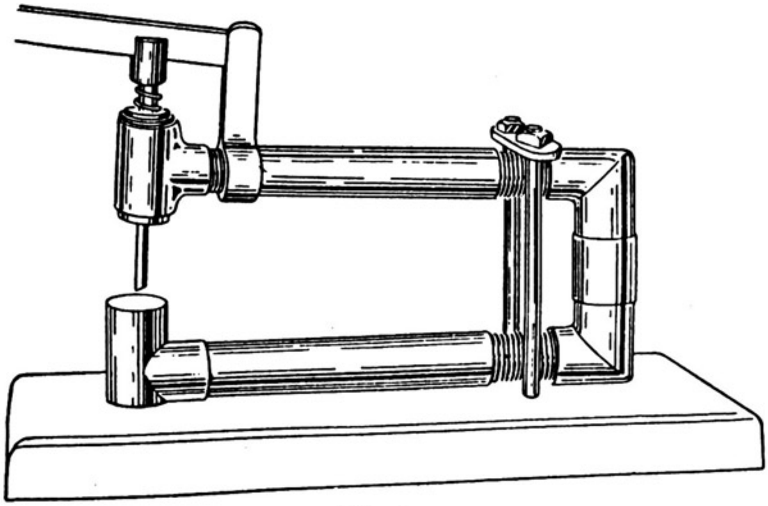


FIG. 63.

is a grub-screw, and being flush with spindle surface the spindle may be withdrawn for new tool to be inserted or tool ground. The table is an old ¾-in. bolt, with saw-cut slot.

It will be seen from drawing (fig. 63) that the strain is taken by the two ⅜-in. bolts at the back.

This press is very useful for slotting metal, such as zinc stencil plates, sheet-iron armature discs, etc., also for punching sheet metal. A similar frame could be utilised as a drill frame or for fretsaw.

41. A Strong Parallel Vice

The back jaw is ½ in. thick by 3 in. broad—bent as shown in fig. 64. The front jaw has a turned part to slide along the back jaw. The bolt is screwed ¾-in. Whitworth, ten threads to the inch. The handle is a piece of $\frac{7}{16}$-in. iron rod, with a ½-in. nut on each end turned bright. The vice grips well—and is a cheap job.

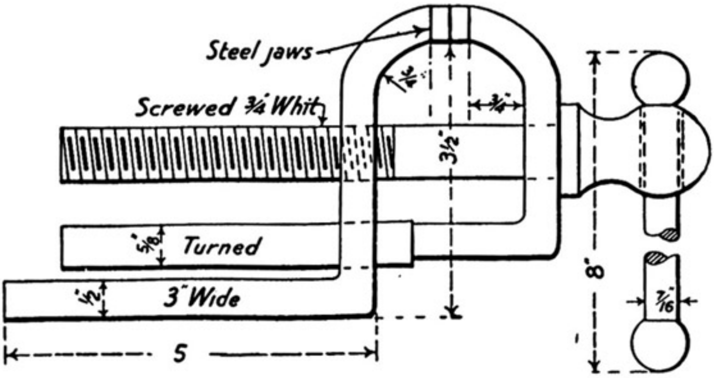


FIG. 64.

42. A Simple Tube Expander

This consists of a piece of tool steel turned (or filed) slightly taper at one end. Four flats should be filed on the tapered part. There should also be no sharp edges. In the sketch (fig. 65) A B is the tapered part. A should fit easily inside the tube, and B should be about $\frac{1}{10}$ in. larger than the inside

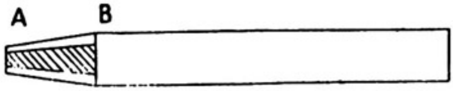


FIG. 65.

diameter of the tube. The flat part is sectioned in the sketch. The point should be lubricated while in use.

43. Screwdriver Made from a File

All workers know what a tantalising habit screwdrivers have of slipping off the work at inconvenient moments, especially when the screw goes rather stiff. The following will show how a screwdriver can be made which will never slip

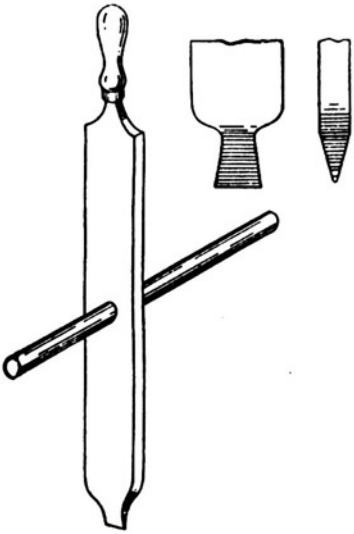


FIG. 66.

off any screw. An old flat file of any length and width must be found, and forged and ground down to the shape shown in fig. 66. A hole of about $\frac{1}{4}$ in. or $\frac{3}{8}$ in. is drilled through the file about half way up after having previously annealed it, and a piece of iron or steel, about 6 in. long, fitted in the hole loosely. The two ends of this " tommy " are then riveted over, and the screwdriver is then complete. To use it, proceed as with the ordinary American brace, using the "tommy" for turning the screwdriver round. In this way a great amount of force can be made to bear on the work, and it will be found that this instrument will successfully overcome the resistance of the most stubborn wood or metal screw.

44. A Simple Drilling Device

In the sketch (fig. 67) A is the drilling-board, which is simply a piece of wood about 6 in. long and 3½ in. wide, covered with a piece of copper sheet to keep it from being split by the drill. To the piece of wood A is fixed vertically the arm B,

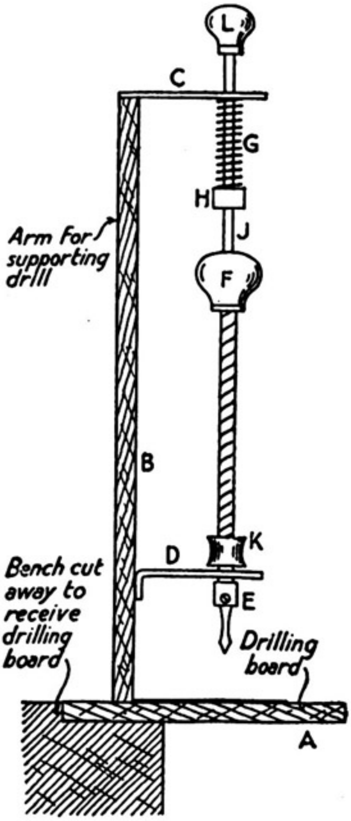


FIG. 67.

which is also of wood, for supporting the drill. To the top of the support B is fixed a copper strip C, 2½ in. long, which supports the drill; and D is a similar strip, which acts as a bottom bearing. The drill is only a simple Archimedean, which is usually employed in fretwork. E is the drill chuck. A hole is drilled vertically into the handle of the drill (F). Into this hole is forcibly driven a steel rod 4 in. long, with a brass bush soldered on 1 in. above the handle of drill. G is a small spring fixed between H and C, fixed so as to press the drill down on to the work. L is a small wooden handle fixed on top of the steel rod on which the hand is placed while drilling to keep the drill steady. K is a small piece of wood by which the drill is revolved. This small drill can be used for wood and metal with equal success.

45. Accurate Gauges

Herewith is described how to produce some accurate distance gauges that are apparently outside the measuring ranges of accurate measuring instruments generally found in engineering workshops. As example, at first sight and though it appears impossible to produce a length gauge of 36·005 in. to within the accuracy of one-thousandth part of an inch with a 12-in. or 6-in. vernier, and a 12-in. vernier being usually the maximum length of accurate measuring tool to be found in a shop. Certainly the large majority of parts requiring so fine an accuracy are under 12 in. long. However, occasionally a longer accurate gauge is required. This is obtained with the use of a 12-in. vernier, as shown in sketch, fig. 68, which shows a length gauge of 36·005 in. This can be, say, a 1-in. diameter mild steel spindle turned in the lathe, with grooves turned in, and the lengths between the grooves a decimal measurement to the 12-in. vernier. The total result of these sizes will be as shown. The quickest way to arrive at the total length will

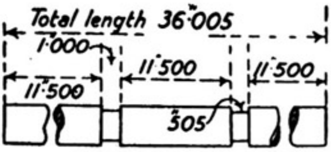


FIG. 68.

be to turn the first and second grooves indiscriminately, say. between 11½ in. and 12 in., and then finish the end off to the correct length to make the overall length correct.

In fig. 69 are shown two hardened plugs pressed in the end of a long-length gauge, to prevent wear when using the gauge. Care must be taken to ascertain that the plugs are pressed right home. A small flat must be filed on plug to allow the air to escape when the plugs are pressed in.

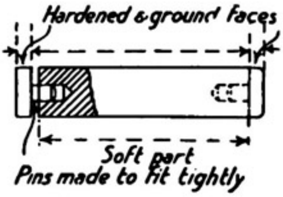


FIG. 69.

In fig. 70 is shown a gauge suitable for gauging the diameter of a bore. The special feature of this is the ordinary steel balls let in the end. These balls, being very hard and sound, ensure taking a true measurement of a bore, and retaining its original length. The length of gauge is made similar to fig. 68, with the ends recessed to receive the balls, as shown at the end in section. This recess should be a little deeper than the half diameter of ball, and the ball then pressed on to the face of this recess, and the metal then caulked around it to hold it secure, as shown in sketch. The recess for receiving the balls must be made the correct depth, so that when the ball is pressed in, the overall length (which is the important point) will be the required length.

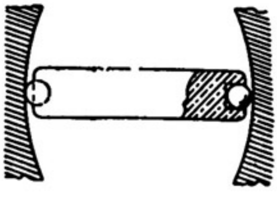


FIG. 70.

46. A Pair of Tongs

On a piece of strong board mount four bosses of hard wood or metal—A, B, C, D, as fig. 71—the two large bosses to be ¾ in. in diameter, and the two small ones ¼ in. in diameter. Around these bosses wind some 1-in. round steel or piano wire, as shown. Reverse the wire, and wind the other half. The lower part of illustration shows finished tongs. By squeezing at E and F the jaws E open, and spring back as the pressure is released. Two large-sized tongs and two small ones form a very useful set for soldering, lacquering, etc.

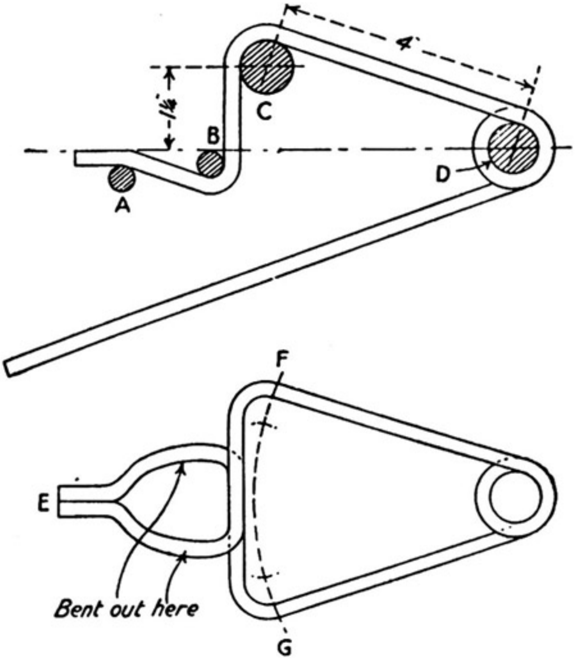


FIG. 71.

47. A Handy Surface Plate Block

This useful article may be made in the following way :—A piece of plate glass, ¼ in. thick by 12 in. by 4 in., is procured at a glass warehouse, and divided into three pieces, making each 4 in. square. One side of each piece is then surfaced on the others with a little fine emery and oil, thus—No. 1 is rubbed in little circular motions on No. 2, then No. 2 is rubbed on No. 3, No. 3 on No. 1, and so on, thus getting the three absolutely flat surfaces. The best two plates are then mounted

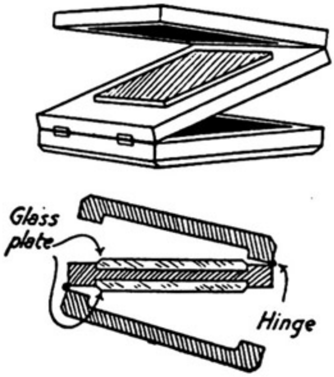


FIG. 72.

in a suitable case, such as is shown in the sketch (fig. 72), having previously bevelled the edges on a grindstone to give a neater appearance. The remaining plate can be kept for rough surfacing, or in reserve in case of accidents to the others. It is not necessary that this surfacing block should be mounted as shown ; any other way would answer just as well, provided the glass is not subject to undue strain in the mounting.

48. A Distance Gauge

This simple gauge can be made out of $\frac{1}{8}$-in. plate entirely. First cut out the guide plate, which should be $5\frac{1}{4}$ in. long and 1 in. wide, and in the centre and $\frac{1}{2}$ in. from one end a slot $\frac{3}{8}$ in. wide and 4 in. long should be cut. The piece of angle steel, shown in sketch (fig. 73), can be made out of a piece of $\frac{1}{8}$-in. plate, 2 in. long and bent at the centre. Two washers are now required, which can be turned out of $\frac{1}{8}$-in. plate, and a milled screw for tightening pieces together. To use this gauge, the angle steel is placed on the edge of the work to be marked, and a mark made against the end of the plate. This is done in another place, and the two marks joined with a rule and

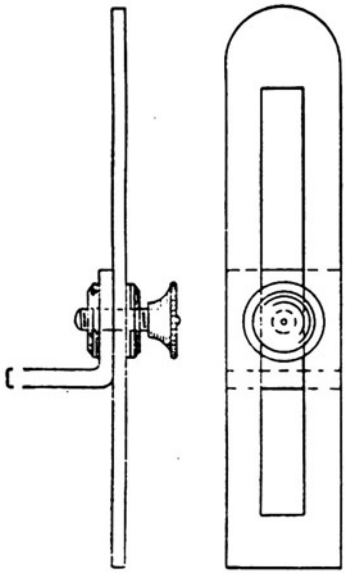


FIG. 73.

scriber. It is obvious that the distance from the end of the plate to the face of angle steel can be altered as required.

49. A Good Emery Grinder

The main body of the machine is an iron casting for two 2-in. bearings, the outside ends of which, as the drawing (fig. 74) shows, are turned down to a slack fit to two dust caps

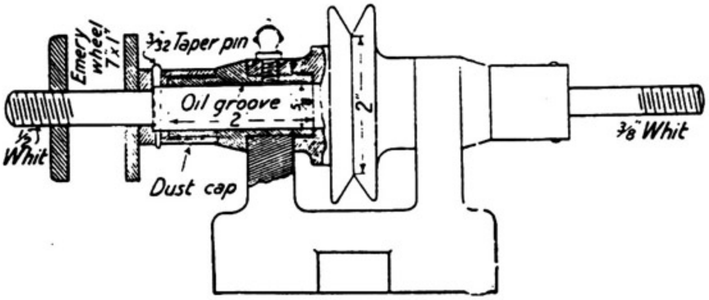


FIG. 74

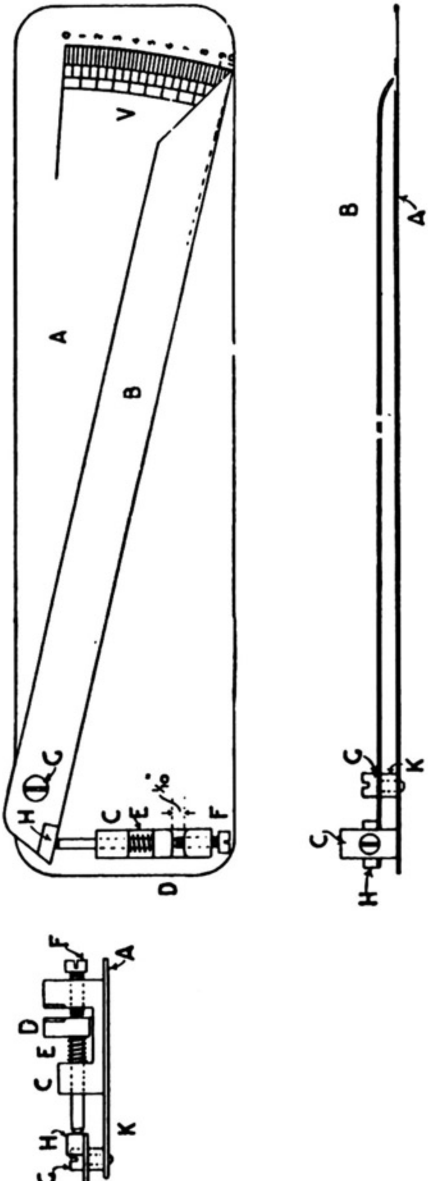


FIG. 75.

driven on the shaft. These dust caps must not fit tight upon the bearing bushes or the result will be too much friction, but clearance of ·002 in. should be allowed. The bushes are produced through each arm of the casting and into two bosses on the pulley bored out to receive them. It will thus be seen that each end of the bearing is absolutely protected from grit. Oil cups with screw caps are fitted to the oil holes on top of the bearings, thus again excluding grit.

The shaft is made of 10 per cent. nickel steel. This, however, is unnecessary, except from a point of wear. The pulley is for a round belt, which will run lighter and give more grip than a flat one.

50. A Home-made Wire Gauge

In fig. 75 A is a piece of stout tinplate, 8 in. by 2 in. B is a broken hacksaw blade, or piece of a clock spring pivoted at G. C is a piece of brass cut to shape, drilled, and one jaw tapped for setscrew F, and then sweated on to A. D is also a piece of brass drilled and tapped for $\frac{1}{8}$ brass wire to be screwed into it and sliding through the left jaw C, and abutting H, thereby moving the pointer B. E is a small steel spring. F is a steel setscrew to open jaws D and C. G is a steel setscrew for pivot B. H is a piece of brass sweated on to B. K is a brass nut sweated on to A. V is the vernier.

To calibrate the tinplate, take your divider, and with G as centre, and from G to the tip of the pointer as radius, describe four arcs; unscrew the setscrew F, allowing the sliding jaw D to meet the right jaw C; press H to end of sliding wire fixed to D; where the pointer cuts the arcs call it 0, then screw up F till jaw D is exactly $\frac{1}{10}$ in. from the right jaw C; press H against end of wire, and where the pointer cuts the arcs call it 10; then divide the arc from 0 to 10 into ten equal parts. Each division will register $\frac{1}{100}$ part of an inch. Now subdivide each part into four.

The pointer now will register ·0, ·0025, ·0050, ·0075, ·01, and so on to ·1 or $\frac{1}{10}$ in.

To test a piece of wire insert it between D and C, turning screw F till a sliding fit is made and then compare the number registered with table of S.W.G. sizes in decimal parts of an inch.